Key Concepts

Food energy is changed into body energy and cycled throughout the body to do work.

The body uses most of its energy supply for basal metabolic needs.

Basic Energy Needs

The body needs constant energy for voluntary and involuntary activity

Voluntary work and exercise

- Includes all physical actions related to usual activities and additional physical exercise
- Seems to require most of the energy output, but is usually not the case

Basic Energy Needs, cont’d

Involuntary work: includes all activities of the body that are not consciously performed

- Circulation, respiration, digestion, absorption

Requirements include:
- Chemical energy: in many metabolic products
- Electrical energy: in brain and nerve activities
- Mechanical energy: in muscle contraction
- Thermal energy: to keep the body warm
Basic Energy Needs, cont’d

Fuel is provided in the form of nutrients

Only three energy-containing nutrients:

- Carbohydrate is primary fuel
- Fat assists as storage fuel
- Protein is a back-up fuel source

Alcohol also provides energy but is not a nutrient

Measurement of Energy

Calorie: Amount of energy in food or expended in physical actions

Kilocalorie (1000 calories or 1 Calorie): Amount of heat necessary to raise 1 kg of water 1°C

- Large Calorie unit used in nutrition science to avoid dealing with large numbers
- Abbreviation: kcalorie or kcal or Cal

Fuel Factors

Carbohydrate: 4 kcal/g

Fat: 9 kcal/g

Protein: 4 kcal/g

Alcohol: 7 kcal/g

Caloric and Nutrient Density

Density: The degree of concentration of material in a given substance

Caloric density: Concentration of energy in a given amount of food
— Foods high in fat have the highest caloric density

• Nutrient density: Concentration of all nutrients in a given amount of food

• Chapter 6  
  Lesson 6.2

• Key Concepts

• A balance between intake of food energy and output of body work energy maintains life and health.

• States of being underweight and overweight reflect degrees of body energy imbalance.

• Energy Balance

• Two energy systems support human life

• External energy cycle: Plants transform radiation from the sun into stored chemical energy (carbohydrates, proteins, and fats)

• Internal energy cycle: Animals, including human beings, use the stored chemical energy for body needs

• Energy Intake

• The body’s energy balance depends on energy intake in relation to energy output

• Energy intake
  — Three macronutrients are stored as:
    • Glycogen
    • Adipose tissue
    • Muscle mass
  — Energy intake is the calculated energy value of actual food consumption

• Energy Output

• Activities to sustain life require energy from food and body reserves
• Three demands for energy determine the body’s total energy requirements
  — Resting energy expenditure (REE)
  — Physical activity
  — Thermic effect of food (TEF)

• Resting Energy Expenditure
• Sum of all internal working activities of the body at rest
• Expressed as kcal/day
• Basal energy expenditure (BEE) is similar to REE but requires complete physical rest (difficult to achieve)

• Measurement of Resting Metabolic Rate
• How are resting metabolic rate (RMR) or basal metabolic rate (BMR) measured?
  — Indirect calorimetry
    • Metabolic rate calculated on the basis of the rate of oxygen utilization
  — Thyroid function test
    • Measures the activity of the thyroid gland and the blood levels of the hormone thyroxine

• Measurement of Resting Metabolic Rate, cont’d

• General formula
  — Men
    • 1 kcal x kg body weight x 24 hours
  — Women
    • 0.9 kcal x kg body weight x 24 hours
• Factors Influencing Basal Metabolic Rate

• Lean body mass (muscles and organs)
  — Greater metabolic activity in lean tissues

• Growth periods
  — Growth hormone stimulates cell metabolism and raises BMR

• Body temperature
  — Fever increases BMR

• Hormonal status
  — Example: Hypothyroidism = Decreased BMR

• Physical Activity

• Energy expenditure for physical activity goes above and beyond energy used for resting energy needs.

• Energy output during physical activity varies widely across individuals.

• Energy Expenditure per Pound per Hour

• Physical Activity Level Factors

• Categorize physical activity level (PAL) according to standard values
  — 1.2: Chair or bed bound
  — 1.4-1.5: Sedentary
  — 1.6-1.7: Very light
  — 1.8-1.9: Moderate
  — 2.0-2.4: Heavy

• Thermic Effect of Food
• After eating, food stimulates metabolism
• Extra energy for digestion, absorption, and transport is required.
• This stimulating effect is called the thermic effect of food (TEF).
• 5% to 10% of the body’s total energy needs for metabolism relate to the processing of food.
• Contributions of RMR, Physical Activity, and TEF on Total Energy Expenditure
• Total Energy Requirement
• Total energy requirement: Resting energy expenditure + Physical activity + TEF
• To maintain daily energy balance:
  — Food energy intake = Body energy output
  — Intake > output = Weight gain (extreme: obesity)
  — Intake < output = Weight loss (extreme: anorexia)
• Life Cycle
• Growth periods
  — Extra energy per unit of body weight is necessary to build new tissue
  — Infancy, adolescence, pregnancy
• Adulthood
  — Energy needs level off
  — With aging, energy needs decline
• Energy Output in Exercise
• Gradual Reduction of Kilocalorie Needs During Adulthood
• Dietary Reference Intakes
• Food and Nutrition Board of the Institute of Medicine created recommendations for energy intake based on gender, age, and other considerations
  — See Table 6-5 in text

• Dietary Reference Intakes, cont’d

• Dietary guidelines for healthy Americans indicate energy needs based on three recommendations:
  — Maintain body weight in a healthy range
  — To prevent gradual weight gain over time, make small decreases in food and beverage calories and increase physical activity
  — Make recommended intakes within energy needs
    • USDA Food Guide
    • DASH eating plan

• Summary

• Energy is the force or power to do work.

• For human beings, food provides energy.

• Energy is measured in “large” calories, or kilocalories.

• Metabolism is the sum of the body processes involved in converting food into various forms of energy.

• Summary, cont’d

• When food is not available for energy, stored energy is used in the form of glycogen, fat, and tissue protein.

• Total body energy requirements are based on:
  — Basal metabolism needs measured by BMR
  — Energy for physical activity
  — TEF
- Energy requirements vary throughout life